



**Military Flying
and Aeromedical Evaluation
of Cardiac Arrhythmias**

By

Kevin T. Mason



Aircrew Protection Division

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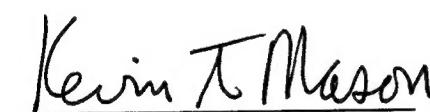
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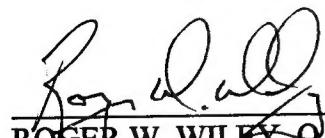
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<p>The evaluation and management of cardiac arrhythmias in military aircrew members are complex, and perhaps, more aggressive than clinical cardiologists, internists, and family physicians expect. However, these policies are based on the needs of the services, mission completion requirements, public safety, and an extensive, ongoing, observational epidemiology research program of the military flying population.</p> <p>This paper summarizes the general considerations of the flying environment as they relate to cardiac arrhythmias. A discussion of the screening principles and epidemiologic confounders is followed by a summary of the joint U.S. Air Force and U.S. Army waiver policy on cardiac arrhythmias and flying duties.</p>			
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The military flying environment

Military relevance

The American Heart Association (AHA) called a scientific conference on personal and public safety issues related to arrhythmias that may impair consciousness. AHA's goal is to develop a task force consensus for publication. AHA tasked the author to state the U.S. Army's aeromedical evaluation of cardiac arrhythmias as it relates to military flying.

General considerations

U.S. military aircrew members fly public use aircraft, rather than private or commercial aircraft. In case of military aircraft mishap, military services carry the full burden of liability for life, as well as private and public property. The public has a high expectation that the military will protect them, while conserving the public's investment in aircrew training and aviation assets. They do not expect military aircraft with hazardous materials to crash into their homes, schools, and businesses.

The U.S. Army (USA) and U.S. Air Force (USAF) own and operate public use aircraft. By federal law, the agency that owns and operates public use aircraft is responsible for the medical certification of agency aircrew members, rather than the Federal Aviation Administration (FAA). So the USA and USAF conduct a physical evaluation program for aircrew members for medical certification of aircrew members. Arrhythmias and other cardiovascular disease risk factors commonly are found during these examinations. Since cardiac arrhythmias may be accompanied by acute incapacitation, increasing the risk for mishap, the USA and USAF have a joint policy on removing aircrew members with high risk cardiac conditions from flying duties.

The joint USA and USAF arrhythmia policy of limiting military flying duties also is based on other concerns. Military services expect their aircrew members to be combat ready and deployable worldwide. On short notice, military aircrew members might operate in isolated situations, or Third World countries with limited medical care facilities. They may eat irregularly, exercise heavily, be subject to circadian desynchronosis and shiftlag, suffer from fatigue, and endure environmental extremes, to include hypoxia and acceleration forces. In these adverse circumstances, military services cannot support the use of antiarrhythmic medications, provide specialized care for cardiac pacers, or treat emergency arrhythmias.

Complicating the matter is these stressful circumstances may produce arrhythmias even in normal individuals. The prognostic significance and risk for incapacitation due to arrhythmias induced by exogenous factors in the military operational environment are unknown.

High performance, fixed-wing missions

Fighter pilots fly in a high performance, fixed-wing mission flying environment. Often flying alone at night or in adverse weather, the pilot is exposed to high acceleration forces and hypoxia at the limits of human tolerance. This environment induces what are likely benign arrhythmias. However, aircrew members with undetected cardiac disease are at increased risk for acute incapacitation due to pathologic arrhythmias. If a pilot suffers acute incapacitation, that pilot usually has no automatic aircraft recovery systems to prevent mishaps.

Low performance, fixed-wing missions

Transport and bomber aircrews fly low performance, fixed-wing missions. In the past, most of these missions outside war zones were not much different from commercial flying with pressurized cabins, environmental control, and automated flight controls. Some fly in near-space conditions in pressurized space suits. The USAF has developed low-level night missions using night vision devices, increasing the complexity of the cockpit environment.

Rotary-wing missions

Rotary-wing pilots fly aggressively near the tree tops, dodging electric wires and towers. Often, they are flying at night using night vision devices. Pilots must remain constantly on the rotary-wing aircraft flight controls without automatic pilot. Cabins usually lack environmental control. Pilots are exposed to whole-body vibrations. Newer rotary-wing aircraft can generate hemodynamically significant acceleration forces. Hypoxia usually is not encountered.

U.S. Air Force and U.S. Army waiver policy on arrhythmias and flying duties

Screening method

The goal of cardiovascular disease screening for USA and USAF aircrew members is to detect subclinical disease and remove the aircrew member from flying duties before symptoms occur. Regarding cardiovascular disease, we deal more often with abnormal tests than clinical symptoms. The dilemma is that most medical studies focus on the management of clinical diseases, rather than on developing risk assessments for abnormal tests found in otherwise asymptomatic individuals.

Since the 1960s, the USA and USAF used observational epidemiology methods to develop their joint policies on the management of cardiac arrhythmias in their aircrew members. The USA and USAF used screening and evaluation protocols, health and safety databases, and followup groups for selected conditions to derive analyses from prospective and retrospective studies.

A major confounder to the study analyses is that military aircrew members are not representative of the general population. They are primarily Caucasian males. They excel in both athletics and scholastics. Most are survivors of a rigorous selection process that included 4 years of military academy or reserve officer (ROTC) training, challenging the mind and body. They must pass several medical examinations. The sick and weak-hearted are not allowed to enter flight training.

Bradyarrhythmias

Sinus bradycardia is a common finding in the physically fit, military aircrew population. Those with heart rates ≤ 40 beats per minute are referred for noninvasive evaluation. Selected aircrew members undergo electrophysiologic study. Aircrew members with normal response to exercise and no evidence of sinus node dysfunction are returned to flying duties. Those with sinus node dysfunction, including those using cardiac pacing, are restricted from flying duties.

Aircrew members with sinus pauses undergo Holter monitoring and graded exercise treadmill test. Those with brief, asymptomatic, and infrequent pauses, less than 4 seconds duration, are returned to flying duties. Selected aircrew members are referred for electrophysiologic studies. Those with symptoms or sinus node dysfunction are restricted from flying duties.

Unifocal or multifocal premature contractions

Aircrew members with premature atrial contractions undergo a noninvasive evaluation to include Holter monitor, and if indicated, echocardiogram and graded exercise treadmill test. If present, aggravating factors such as thyroid disease, nicotine and caffeine abuse, and alcohol abuse are treated before making a final disposition. Aircrew members with benign findings are returned to unrestricted flying duties, while those with underlying heart disease or other associated extracardiac abnormalities are returned to flying duties on a case-by-case basis.

Aircrew members with premature ventricular contractions (PVCs) undergo a noninvasive evaluation to include Holter monitor. If more than 10 percent of beats are PVCs, the aircrew member undergoes additional testing to include graded exercise treadmill test, echocardiogram, and cardiac fluoroscopy (to rule out cardiac calcifications). Those at risk for coronary artery disease may undergo coronary angiography, if indicated. Aircrew members with infrequent PVCs and no evidence of cardiac disease are returned to flying duties. Those with underlying heart disease or other extracardiac abnormalities are returned to flying duties on a case-by-case basis.

Ventricular tachycardia

Aircrew members with 3 or more ventricular beats in a row at a rate ≥ 100 beats per minute are restricted from flying duties pending further evaluation. Those with a single run of ventricular tachycardia (VT) are returned to low performance flying duties if they have three normal Holter monitors over 3 months, normal echocardiogram, normal exercise treadmill test, and no evidence of organic heart disease. Selected aircrew members, primarily those age 36 or older, also undergo coronary angiography. Those with recurrent VT, or a single episode of VT complicated by any degree of coronary artery occlusion or other cardiac conditions, are restricted from flying duties.

Supraventricular tachycardia

Aircrew members with three or more supraventricular beats in a row are restricted from flying duties pending further evaluation. Those with only a single run of 3 to 10 beats of supraventricular tachycardia (SVT) are returned to flying duties if they have three normal Holter monitors over 3 months, normal thyroid function tests, and normal echocardiogram and exercise treadmill test. Those with greater than 10 beats of SVT or recurrent SVT undergo a tertiary aeromedical cardiology consultation, which may include cardiac catheterization with coronary angiography and/or electrophysiologic studies. Selected individuals are returned to flying duties, but those with other conditions, such as ventricular tachycardia, early aortic insufficiency, and minimal coronary artery disease, may be restricted to low performance aircraft only. Aircrew members with SVT and significant coronary artery disease, SVT and Wolff-Parkinson-White pattern, hemodynamically unstable SVT, or recurrent sustained SVT are not returned to flying duties.

Wolff-Parkinson-White pattern and syndrome

Aircrew members with Wolff-Parkinson-White (WPW) pattern may return to flying duties if a noninvasive cardiovascular evaluation is normal. Aircrew members with WPW syndrome are restricted from flying duties. Selected aircrew members with WPW syndrome may return to flying duties following complete recovery from radiofrequency ablation of their bypass tract. They must have multiple normal Holter monitor tracings over 6 months. Then, a repeat electrophysiologic study must show no missed or concealed bypass tracts and propensity for ventricular arrhythmias.

Conduction dysfunction

Aircrew members with first degree AV block with normalization during exercise are returned to flying duty. Mobitz Type I AV block is a normal variant finding in military aircrew members and does not result in flying duty restriction. Those with Mobitz Type II AV block or third degree AV block, with or without cardiac pacing, are restricted from flying duties.

Aircrew members with congenital right bundle branch block (RBBB) and normal echocardiograms are allowed to enter flight training. Those with acquired RBBB are returned to flying duties if they have a normal noninvasive evaluation, to include graded exercise treadmill test, echocardiogram, and Holter monitor.

Aircrew members with left bundle branch block are restricted from flying duties pending further evaluation. They are referred for tertiary aeromedical cardiology consultation. Those with normal noninvasive evaluations, and normal cardiac catheterization studies to include coronary angiography and electrophysiologic studies, are returned to flying duties. Those with other cardiac findings, such as coronary artery occlusions, valvular heart disease, prolonged HIS-ventricular interval, cardiomyopathy, etc., are restricted from flying duties.

Summary

The evaluation and management of cardiac arrhythmias in military aircrew members are complex, and perhaps, more aggressive than clinical cardiologists, internists, and family physicians expect. However, these policies are based on the needs of the services, mission completion requirements, public safety, and an extensive, ongoing, observational epidemiology research program for our population.

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